T. E.

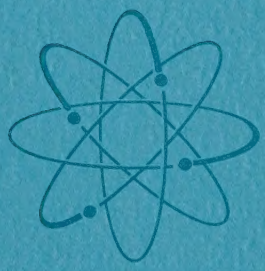
Model 111

PRE AMPLIFIER

LTV
LING-TEMCO-VOUGHT, INC.

LING
ELECTRONICS DIVISION

INSTRUCTION MANUAL



Model
111
PREAMPLIFIER

IN ALL CORRESPONDENCE WITH THE FACTORY BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

EQUIPMENT MODEL NUMBER

SERIAL NO. 198

LING NO. 42521

LTV LING ELECTRONICS Division
LING-TEMCO-VOUGHT, INC.
1515 So. Manchester Avenue
Anaheim, California

34-2

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SECTION 1
DESCRIPTION AND CHARACTERISTICS

1-1. INTRODUCTION

The Ling Electronics Model 111 Preamplifier basically consists of a 6SN7 paraphase balanced amplifier and a 35T push-pull amplifier. The preamplifier output supplies the push-pull power amplifier tubes (V1 and V2, 3X3000F1) with the required power.

TABLE 1-1 TUBE COMPLEMENT

DESIGNATION	TYPE	FUNCTION
1V1	6SN7GTB	Input amplifier and paraphase amplifier.
1V2	6SN7GTB	Balanced voltage amplifier.
1V3	35T	Voltage amplifier
1V4	35T	Voltage amplifier.
1V5	2X2A	Bias supply rectifier.
1V6	5R4	Full wave rectifier.

SECTION 2
OPERATION

2-1. INSTALLATION

The 111 Preamplifier is an integral part of the power amplifier, therefore, no installation instructions are required.

TABLE 2-1 FRONT PANEL CONTROLS, INDICATORS AND METERS (see figure 2-1)

PANEL MARKING	DESIGNATION	DESCRIPTION AND FUNCTION
P.A. 1	1M2	Ammeter: indicates the cathode current of power amplifier tube V1 (3X3000F1).
P.A. 2	1M1	Ammeter: indicates the cathode current of power amplifier tube V2 (3X3000F1).
BIAS 1	1R43	Potentiometer (screwdriver adjustment); adjusts the bias voltage of power amplifier tube V1.
BIAS 2	1R42	Potentiometer (screwdriver adjustment): adjusts the bias voltage of power amplifier tube V2.
AMPLIFIER BALANCE	1R6	Potentiometer (screwdriver adjustment): balances the signal between the P.A. tubes in the amplifier (3X3000F1).
HUM BALANCE 1 and 2	1R26 and 1R27	Potentiometer (screwdriver adjustment): minimum hum and noise adjustment for tubes 1V3 and 1V4.

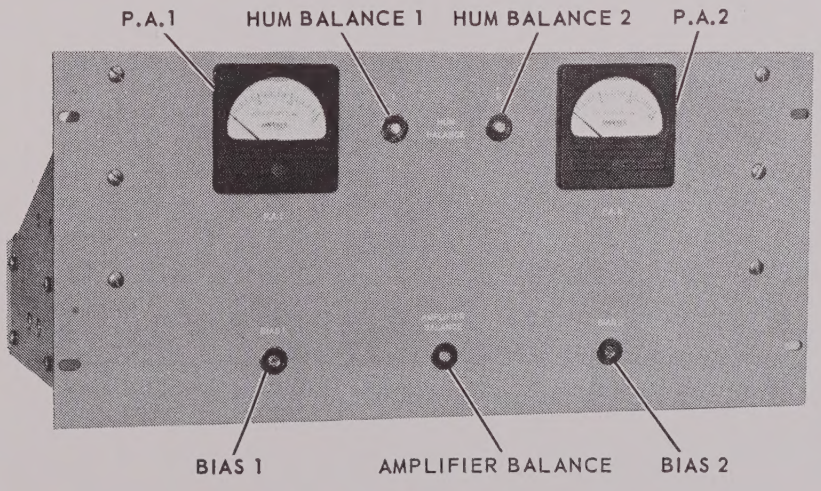

Fig. 2-1 Model 111 Preamplifier, Front View

SECTION 3
PRINCIPLES OF OPERATION

3-1 CIRCUIT DESCRIPTION (refer to figure 3-1)

a. The input to voltage amplifier 1V1A is derived from the OUTPUT control located in the amplifier. When the OUTPUT control is fully counterclockwise, no signal is applied. The output of 1V1A is coupled to 1V1B through a divider network. The amplified output of 1V1B is then applied to voltage amplifier 1V2 where it is further amplified and applied to the grids of push-pull amplifiers 1V3 and 1V4; 1V3 and 1V4 drive the 3X3000 final amplifiers.

b. Trimmer capacitor 1C7 permits the adjustment of the output of 1V1B (relative to 1V1A) at higher frequencies, thereby obtaining two outputs 180 degress out of phase. This adjustment is made at the factory. However, it is possible that in changing tubes, an unbalanced condition may exist. This would necessitate the re-adjustment of 1C7 (this procedure is covered in the test and calibration section of this manual).

c. Potentiometers are provided for amplifier balance (1R6), hum balance (1R26 and 1R27) and bias adjustments (1R42 and 1R43). These potentiometers are pre-set at the factory for optimum performance, but can be adjusted as required (i.e. as the tubes age, changing of tubes etc.).

d. Filament power for tubes 1V3 and 1V4 is provided by filament transformers 1T1 and 1T2. The negative voltage for power amplifier bias is obtained from transformer 1T3. This voltage is rectified by bias supply rectifier tube 1V5 and filtered by an RC network composed of 1R52, 1R53, 1C8 and 1C18. Transformer 1T4 provides 6.3 vac for the filaments of tubes 1V1 and 1V2. Voltage from the high voltage secondary of 1T4 is rectified by 1V6 and filtered by one pi-section of L-C filtering composed of 1C9, 1R41, 1C12. Resistors 1R47, 1R49 and 1R50 form bleeder networks across the capacitors.

e. The approximate voltage of +480 volts (supplied by the power supply) is used as plate voltage by 1V2. The plate voltage of 1V2 is approximately +280 volts, D.C. The plate voltage for 1V1 is reduced to approximately +208 volts by decoupling network 1R45 and 1C13 and plate load resistors 1R1 and 1R3.

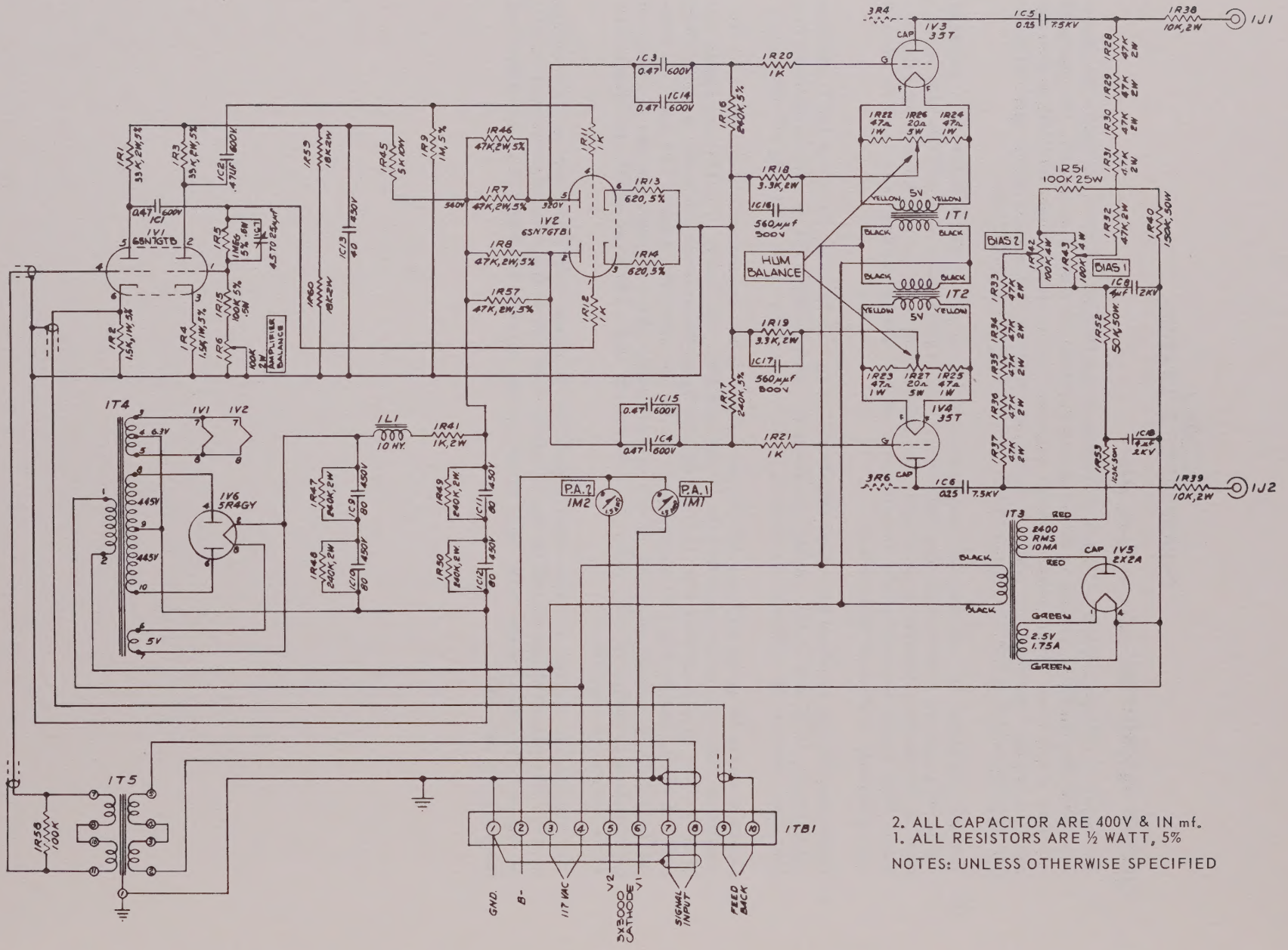

Fig. 3-1 Model 111 Preamplifier, Complete Schematic

SECTION 4 - MAINTENANCE

4-1. ANALYSIS

a. The first step in servicing a defective Model 111 Preamplifier is to localize the fault. Some faults, such as burned out resistors, arcing and shorted transformers can be located by sight, smell or sound.

b. Listed below are a few tests arranged to simplify and reduce unnecessary work and aid in tracing a trouble to a specific circuit or component:

(1). Visual inspection may disclose the trouble or determine the circuit in which the trouble exists (refer to figure 4-1 and 4-2).

(2). Intermittent conditions should not be overlooked when conducting these tests. This type of trouble may often be located by tapping or jarring the equipment.

(3). Voltage and resistance measurements will help to locate the defective component(s) when the readings taken are compared with the normal readings listed in paragraph 4-3.

4-2. TEST EQUIPMENT

NOTE

THE FOLLOWING TEST EQUIPMENT CAN BE REPLACED BY ANY SUITABLE EQUIVALENT.

a. Audio oscillator, Hewlett Packard Model 200C.

b. Distortion analyzer, Hewlett Packard Model HO1-330B.

c. Oscilloscope, Hewlett Packard Model 120AR.

d. Varic, General Radio Model W5MT3.

e. Wattmeter, Triplett Model 660.

f. Multimeter, Simpson Model 270 VOM.

4-3. TESTING AND CALIBRATION (refer to the schematic)

a. Continuity and resistance test.

(1). Check for open circuit resistance in the following:

(a). 1TB1 - 1 to 1TB1 - 10.

(b). 1TB1 - 1 to 1TB1 - 2.

(c). 1TB1 - 1 to 1TB1 - 7.

(2). Check that the following measure a resistance of less than 0.5 ohm:

(a). 1TB1 - 1 to ground stud.

(b). 1TB1 - 9 to pin 6 of tube 1V1.

(3). Measure the resistance from 1TB1-2 to 1TB1-6 (use ohm x 1 scale). Connect the plus (+) lead to 1TB1-6. The P.A. 1 meter should deflect upscale.

(4). Measure the resistance from 1TB1-2 to 1TB1-5 (use ohm x 1 scale). Connect the plus (+) lead to 1TB1-5. The P.A. 2 meter should deflect upscale.

(5). Set BIAS 1 and BIAS 2 controls fully clockwise. Measure the resistance between the points listed in TABLE 4-1.

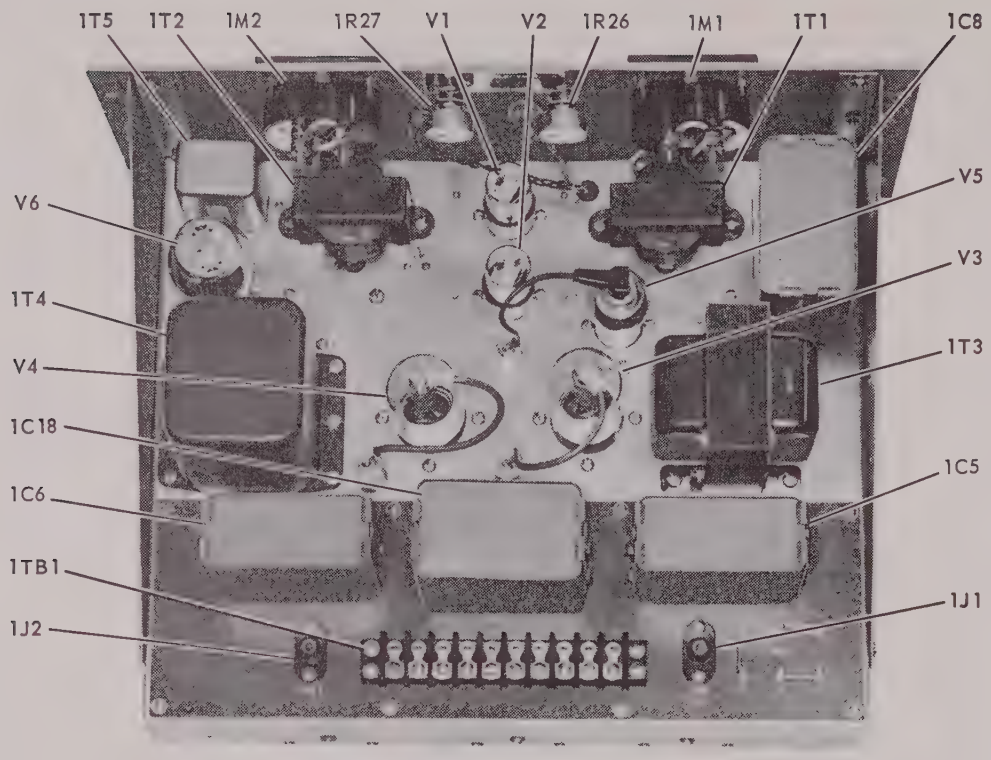

Fig. 4-1 Model 111 Preamplifier, Top View

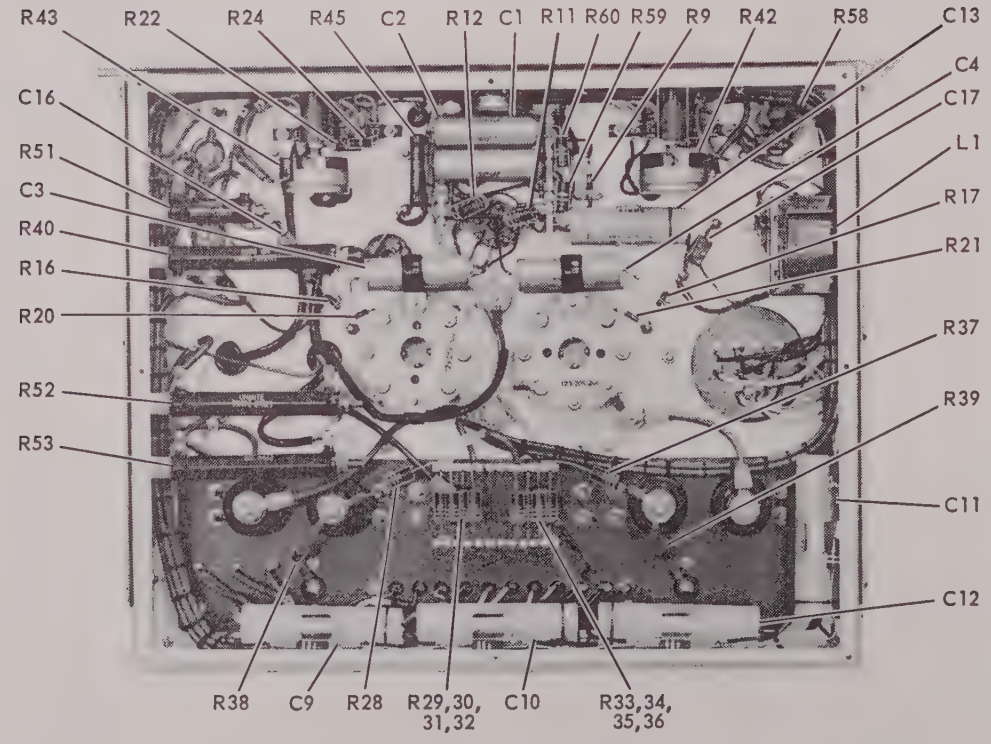

Fig. 4-2 Model 111 Preamplifier, Bottom View

NOTE

THE RESISTANCE SHOULD BE BETWEEN THE LIMITS TABULATED.

TABLE 4-1 CIRCUIT RESISTANCE CHECKS

CIRCUIT	APPROX. LIMIT
1J1 to 1J2	440K to 540K
1J1 to BIAS 2	220K to 270K
1J1 to BIAS 2*	50K increase from clockwise to counterclockwise.
1J2 to BIAS 2**	50K increase from clockwise to counterclockwise.
1TB1-1 to BIAS 2	225K to 275K
BIAS 1 to BIAS 2	110K to 140K
BIAS 1 to the plate plate cap of 1V5	90K to 110K

* Set BIAS 1 counterclockwise. The resistance should increase 50K.

** Set BIAS 2 counterclockwise. The resistance should increase 50K.

NOTE

GROUND PIN 9 OF 1T4. BE SURE B- IS GROUNDED.

b. Tube complement

Remove 1V3, 1V4 and 1V5.

c. External connections.

(1). Connect instrumentation ground to 1TB1-1.

(2). Jumper 1TB1-10 to 1TB1-2.

(3). Connect the output of the oscillator to 1TB1-7 and 8.

(4). 60 cps line (wattmeter output) to 1TB1-3 and 4.

(5). Jumper 1TB1-1 and 1TB1-2.

WARNING

THE BIAS CIRCUIT ON THIS CHASSIS HAS A 2400 VAC SOURCE FOR BIAS RECTIFICATION. THIS SUPPLY IS ENERGIZED WHENEVER 117V IS APPLIED TO 1TB2 AND 1TB4. CARE MUST BE TAKEN IN TESTING FOR UNDER CHASSIS VOLTAGES. HIGH VOLTAGE IS PRESENT ON THE HIGH VOLTAGE RESISTORS IN THE BIAS CIRCUITRY AND THE FEED-THROUGH INSULATOR AND PLATE CONNECTOR FOR 1V5.

d. Voltage measurements.

(1). Measure the plate supply voltage at the junction of 1R7, 1R8, 1R46, 1R57. The voltage reading should be approximately +480 vdc.

(2). The plate voltage of 1V1, pin 2 and pin 5 should be approximately +205 vdc.

(3). The plate voltage if 1V2, pin 2 and pin 5 should be approximately +220 vdc.

(4). Measure the filament voltage of 1V1 and 1V2. The voltage reading obtained should be 6.3 vac.

(5). The cathode voltage reading of tube 1V1, pin 3 and pin 6, should be approximately +7.8 vdc.

(6). The cathode voltage reading of tube 1V2, pin 3 and pin 6, should be approximately +6.2 vdc.

(7). Measure the filament voltage for 1V3 and 1V4. This should be between 5.2 and 5.8 vac unloaded.

e. RMS voltage readings at 500 cps.

(1). Measure the rms voltage of 1V1 at pin 4. This should be approximately 0.75 vrms.

(2). Measure the rms voltage of 1V1 at pins 3 and 6. This should be approximately 0.3 vrms.

(3). Measure the rms voltage of 1V1 at pins 2 and 5. This should be approximately 6 vrms.

(4). Measure the rms voltage of 1V2 at pins 2 and 5. This should be approximately 70 vrms.

f. Amplifier gain.

(1). Set the oscillator for 500 cps.

(2). Adjust the audio input voltage (tp 1TB1-7 and 8) and the amplifier balance controls for 70 volts rms from B- ground to the grids of 1V3 and 1V4 (junction of 1C3, 1C14 and 1R16, and the junction of 1C4, 1C15 and 1R17).

(3). The input voltage required for 70 volts rms grid drive will be approximately 0.3 volt rms.

g. Phase adjustment.

(1). With unshielded, single conductor leads, connect the grid of 1V3 to the vertical oscilloscope amplifier and the grid of 1V4 to the horizontal oscilloscope amplifier.

(2). Adjust the audio input and frequency of 1V3 and 1V4 grid voltages at 7KC until 70 volts rms is obtained.

(3). Adjust 1C7 for 180 degree phase shift.

h. Distortion.

(1). Measure the total harmonic distortion at the grids of 1V3 and 1V4 (output of 70 volts rms) at 20 cps, 50 cps, 1KC and 3KC. The distortion should be less than 2%.

(2). Change the setting of 1C7 for minimum distortion at the grids of 1V4 at 3KC.

i. Frequency response.

(1). Measure the frequency response of the amplifier at the grids of 1V3 and 1V4.

(2). Use 500 cps as a reference. With a dc scope, keep the audio input voltage constant at 0.1 volt.

(3). The frequency response should be within limits listed in Table 4-2.

TABLE 4-2 FREQUENCY RESPONSE

FREQUENCY	APPROXIMATE VALUE
5 cps	-4 to -8 db
10 cps	-1½ to 3½ db
500 cps	Reference
10 KC	+0.3 to +1.0 db
24 KC	+2.0 to +3.5 db
50 KC	-8.0 to 11.0 db
100 KC	-22 to -27 db

j. Amplifier noise.

(1). Short the audio input leads to 1TB1-7 and -8. Measure the noise at the grids of 1V3 and 1V4.

(2). The noise should be less than 70 mv (i.e. 60 db below 70 volts rms).

k. Driver check

NOTE

WITH 1V3 AND 1V4 INSTALLED, THE CHASSIS MUST BE IN A VERTICAL PLANE AND NOT ON ITS SIDE.

(1). With power off, connect a 100K plate load resistor from 1V6-2 to the plates of 1V3 and 1V4 (beneath chassis). Install 1V3 and 1V4. Apply power and adjust the audio input to TB1-7 and -8 (at 500 cps) for 70 volts rms from B- ground to 1J1 and 1J2. The input voltage required should be approximately 0.3 vrms.

(2). Short the audio input to TB1-7 and -8. Observe the output noise voltage at 1J1. Adjust HUM BALANCE 1 for a minimum of 60 and 120 cps hum noise. The noise should be less than 3 volts rms.

(3). Measure the power consumption. The consumption should be less than 140 watts.

l. Bias measurements.

(1). Turn the line power off. Install 1V5 and connect the voltmeter (-5000 vdc full scale) from ground to 1J1. Turn the line power on.

(2). Adjust BIAS 1 control from maximum clockwise to maximum counterclockwise. The maximum bias at maximum counterclockwise should be between -1100 and -1300 vdc. The bias range should be 200 vdc.

(3). Turn the line power off. Disconnect the meter after the voltage reduces to zero. Measure the bias range for 1J2 as in 1J1, using BIAS 2 for adjustment.

4-4. OTHER DIFFICULTIES

In the event of troubles or problems not covered by this manual, contact the factory, giving the serial number of the unit, conditions of use and a full description of the problem. Ling field service engineers are available for consulatation on special problems concerning the utilization or application of Ling equipment.

TABLE 4-3 MODEL 111 PREAMPLIFIER PARTS LISTS

REF. DESIG.	DESCRIPTION	LING STOCK NUMBER	MFG.	MFG. PART NUMBER
1C1	Capacitor, Paper Dielectric 0.47 mfd, 600V	82053-0474	WP	18M6474-1
1C2	Capacitor, Paper Dielectric 0.47 mfd, 600V	82053-0474	WP	18M6474-1
1C3	Capacitor, Paper Dielectric 0.47 mfd, 600V	82053-0474	WP	18M6474-1
1C4	Capacitor, Paper Dielectric 0.47 mfd, 600V	82053-0474	WP	18M6474-1
1C5	Capacitor, 0.25 mfd, 7.5 KV	82049-0024	SA	7175- .25HV
1C6	Capacitor, 0.25 mfd, 7.5 KV	82049-0024	SA	7175- .25HV
1C7	Capacitor, Ceramic Trimmer 4.5 to 25 mmfd	82051-0003	ER	CV 11A250
1C8	Capacitor, 4 mfd, 2KV	82049-0016	GE or SA	23F383 7120-4
1C9	Capacitor, Fixed Electrolytic 80 mfd, 450V	82054-0806	SP	TVA-1716
1C10	Capacitor, 80 mfd, 450 V	82054-0806	SP	TVA-1716
1C11	Capacitor, 80 mfd,-450 V	82054-0806	SP	TVA-1716
1C12	Capacitor, 80 mfd, 450 V	82054-0806	SP	TVA-176
1C13	Capacitor, Fixed Electrolytic 40 mfd, 450V	82054-0406	SP	TVA-1712
1C14	Capacitor, 0.47 mfd, 600V	82053-0474	WP	18 M6474-1
1C15	Capacitor, 0.47 mfd, 600V	82053-0474	WP	18M6474-1
1C16	Capacitor, Mica Dielectric 500 mmfd, 500V	82026-0561J	MENCO	CM-20D-561-J
1C17	Capacitor, Mica Dielectric 500 mmfd, 500V	82026-0561J	MENCO	CM-20D-561-J
1C18	Capacitor, 4 mfdm 2KV	82049-0016	GE or SA	23F383 7120-4
1J1	Connector, High Voltage	80100-0100	M	37001 Black
1J2	Connector, High Voltage	80100-0100	M	37001 Black
1L1	Reactor, 10H, 90MA, 270 ohm, 1500 VRMS Test Voltage	82071-0005	T	C7X
1M1	Meter, Plate Current, Non-Magnetic, O to 1.5 a	82360-0013	GE	Size RX-351, DO-91
1M2	Meter, Plate Current, Non-Magnetic, 0 to 1.5 a	82360-0013	GE	Size RX-351, DO-91
1R1	Resistor 33K, 2W, 5%	82232-0333J	O	
1R2	Resistor 1.5K, 1W, 5%	82231-0152J	O	
1R3	Resistor 33K, 2W, 5%	82232-0333J		
1R4	Resistor 1.5K, 1W, 5%	82231-0152J	O	
1R5	Resistor 1 Meg, 1/2 W, 5%	82230-0105J	O	
1R6	Potentiometer 100 K, 2W, 2%	82253-0104K	O	CU1041
1R7	Resistor 47K, 2W, 5%	82232-0473J	O	
1R8	Resistor 47K, 2W, 5%	82232-0473J	O	
1R9	Resistor 1 Meg, 1/2 W, 5%	82230-0105J	O	
1R11	Resistor 1K, 1/2W, 5%	82230-0102J	O	

TABLE 4-3 MODEL 111 PREAMPLIFIER PARTS LISTS

REF. DESIG.	DESCRIPTION	LING STOCK NUMBER	MFG.	MFG. PART NUMBER
1R12	Resistor 1K, 1/2W, 5%	82230-0102J	O	
1R13	Resistor 620 ohm, 1/2W, 5%	82230-0621J	O	
1R14	Resistor 620 ohm, 1/2W, 5%	82230-0621J	O	
1R15	Resistor 100K, 1/2W, 5%	82230-0104J	O	
1R16	Resistor 240K, 1/2W, 5%	82230-0244J	O	
1R17	Resistor 240K, 1/2W, 5%	82230-0244J	O	
1R18	Resistor 3.3K, 2W, 5%	82232-0332J	O	
1R19	Resistor 3.3K, 2W, 5%	82232-0332J	O	
1R20	Resistor 1K, 1/2W, 5%	82230-0102J	O	
1R21	Resistor 1K, 1/2W, 5%	82230-0102J	O	
1R22	Resistor 47 ohm, 1W, 5%	82231-0470J	O	
1R23	Resistor 47 ohm, 1W, 5%	82231-0470J	O	
1R24	Resistor 47 ohm, 1W, 5%	82231-0470J	O	
1R25	Resistor 47 ohm, 1 W, 5%	82231-0470J	O	
1R26	Potentiometer 20 ohm, 5W	82256-0200	CRL	WN-200
1R27	Potentiometer 20 ohm, 5W	82256-0200	CRL	WN-200
1R28	Resistor 47K, 2W, 5%	82232-0473J	O	
1R29	Resistor 47K, 2W, 5%	82232-0473J	O	
1R30	Resistor 47K, 2W, 5%	82232-0473J	O	
1R31	Resistor 47K, 2W, 5%	82232-0473J	O	
1R32	Resistor 47K, 2W, 5%	82232-0473J	O	
1R33	Resistor 47K, 2W, 5%	82232-0473J	O	
1R34	Resistor 47K, 2W, 5%	82232-0473J	O	
1R35	Resistor 47K, 2W, 5%	82232-0473J	O	
1R36	Resistor 47K, 2W, 5%	82232-0473J	O	
1R37	Resistor 47K, 2W, 5%	82232-0473J	O	
1R38	Resistor 10K, 2W, 5%	82232-0103J	O	
1R39	Resistor 10K, 2W, 5%	82232-0103J	O	
1R40	Resistor 150K, 50W, 5%	82245-0154J	O	
1R41	Resistor 1K, 2W, 5%	82232-0102J	O	
1R42	Potentiometer 100K, 4W, FKS 1/4 shaft	82257-0001	Clarostat	10-100K
1R43	Potentiometer 100K, 4W, FKS 1/4 shaft	82257-0001	Clarostat	10-100K
1R45	Resistor 5K, 10W	82237-0502J	O	Brown Devil
1R46	Resistor 47K, 2W, 5%	82232-0473J	O	
1R47	Resistor 240K, 2W, 5%	82232-0244J	O	

TABLE 4-3 MODEL 111 PREAMPLIFIER PARTS LIST

REF. DESIG.	DESCRIPTION	LING STOCK NUMBER	MFG.	MFG. PART NUMBER
1R48	Resistor 240K, 2W, 5%	82232-0244J	O	
1R49	Resistor 240K, 2W, 5%	82232-0244J	O	
1R50	Resistor 240K, 2W, 5%	82232-0244J	O	
1R51	Resistor 100K, 25W, 5%	82244-0104J	O	0229
1R52	Resistor 50K, 50W, 5%	82245-0503J	O	0420
1R53	Resistor 100K, 50W, 5%	82245-0104J	O	0422
1R57	Resistor 47K, 2W, 5%	82232-0473J	O	
1R58	Resistor 100K, 1/2W, 5%	82232-0104J	O	
1R59	Resistor 18K, 2W, 5%	82232-0183J	O	
1R60	Resistor 18K, 2W, 5%	82232-0183J	O	
1TB1	Terminal Strip	80112-0058	CJ	10-142-Y
1T1	Transformer, Filament 5V at 6A	82308-0003	T	F-8X
1T2	Transformer, Filament 5V at 6A	82308-0003	T	F-8X
1T3	Transformer, Plate and Filament	82309-0020	THORDARSON	24R92
1T4	Transformer, Power	82309-0018	CH	PSR-105
1T5	Transformer, Input	82305-0004	PE	15149
1V1	Tube	82130N0036	RCA	6SN7GTB
1V2	Tube	82130N0036	RCA	6SN7GTB
1V3	Tube	82130N0047	EI	35T
1V4	Tube	82130N0047	EI	35T
1V5	Tube	82130-0007	RCA	2X2A
1V6	Tube	82130-0016	RCA	5R4GY
1XV1	Socket, Tube	82280-0016	AMP	77M1P8T
1XV2	Socket, Tube	82280-0016	AMP	77M1P8T
1XV3	Socket, Tube	82280-0021	J	123-209-200
1XV4	Socket, Tube	82280-0021	J	123-209-200
1XV5	Socket, Tube	82280-0015	AMP	77M1P4
1XV6	Socket, Tube	82280-0016	AMP	77M1P8T
1XT7	Socket, Input Transformer	82280-0018	AMP	77M1P11T

CODE TO MANUFACTURERS

AA	AIR ASSOCIATES
AB	ALLEN BRADLEY
AC	ASTRON CORPORATION
ACDC	ACDC ELECTRONICS
AD	ADVANCE RELAY
AD-YU	AD-YU LABS
ADEL	ADEL
ADMS	ADAMS & WESTLAKE
AH & H	ARROW-HART & HEGEMAN
AI	AIRCRAFT
AIRM	AIR MARINE PRODUCTS
ALB	ALBION
ALL	ALLIS CHAMBERS
AMC	AMSCO
AME	AMPERITE CO.
AMM	AMMON INSTRUMENTS INC.
AMP	AMPHENOL
AMPX	AMPEX
AP	AIR PAX
APH	ALPHA
API	AMERICAN PAMCOR INC.
AQ	AEROQUIP
AR	AEROVOX
ARCO	ARCO ELECTRONICS
ARM	ARMSTRONG CORK CO.
AS	ASSOCIATED SPRING
ASP	ASSEMBLY PRODUCTS
ATLE	ATLEE
AUTO	AUTOMATIC ELECTRIC
BAS	BASSICK
BC	BARBAR COLMAN
BECK	BECKMAN INSTRUMENTS
BEL	BELDEN
BEN	BENDIX
BG	BOSTON GEAR
BI	BIRNBACH
BIRT	BIRTCHER
BO	BODINE
BOU	BOURNS "TRIMPOT"
BOW	BOWERS
BP	BOGEN-PRESTO
BRE	BREEZE "AERO SEAL"
BRY	BRAYANT
BUD	BUD
BUCH	BUCHANAN
BUG	BUGGIE
BUR	BURROUGHS
BUSS	BUSSMAN MFG.
B & K	BRUEL & KJAER
C	CHATHAM
CA	CARLING ELECTRIC
CAL	CALIDYNE
CALC	CALIFORNIA CHASSIS
CAN	CANNON
CCI	CONTINENTAL CARBON, INC.
CD	CORNELL DUBILIER
CH	CHICAGO STANDARD TRANS.
CHD	CROUSE HINDS
CHSH	CHASE-SHAWMUT
CI	CINEMA
CJ	CINCH-JONES
CK	CONROY & KNOWLTON
CL	CLARK CONTROLER CO.
CLAR	CLAROSTAT
CM	COMPUTER MEASUREMENTS
COR	CORNISH
CP	COMMUNICATION PROD.
CRA	CRAMER
CRAF	CRAFTSMAN
CRIT	CRITTENDEN
CRL	CENTRALAB
CRN	CRANE
CT	CHASSIS TRAK
CTS	CH. TELE SUPPLY
CU	CURTIS
CUT	CUTLER HAMMER
D & H	D & H AWNING
DA	DAYTON
DALE	DALE
DECO	DEECO
DEFT	DEECO FELT
DELR	DELRY
DI	DIALITE CORP. (DIALCO)
DICO	DIAMOND MFG. (DICO)
DM	DIAMOND METAL
DRAK	DRAKE - ATWOOD
DUC	DUCOMMON
DUM	DUMOND
DY	DYMEC
ECK	ECKTRONICS
ED	EDCLIFF INST.
EEW	ELECTRO ENG. WORKS
EF	ELECTRO FAB.
EI	EIMAC
EM	ELECTRO-MEASUREMENTS
ELCO	ELCO
ELME	ELMENCO
ELTC	ELECTRAC
EMC	EMCOR
EMEC	EMEC
EMP	EMPCO
ENDV	ENDEVCO
EP	ENGINEERING PROD.
ER	ERIE
ERA	ELECTRONIC RESEARCH ASSOC.
ERC	ELECTRA RESISTOR CORP.
ES	EAGLE SIGNAL
ESCO	ELECTOR-SWITCH CORP.
ESX	ESSEX
EVER	EVEREST
F	FENWAL
FAN	FANSTEEL
FED	FEDERATED
FED-S	FEDERAL SCREW
FEI	FEDERAL ENTERPRISE, INC.
FF	FEDERAL FASTENING
FP	FISHER-PORTER
FR	FRANZ
FU	FULLER
ITT	FEDERAL (IT & T)
G	GRAYBAR
GA	GATES
GAXY	GALAXY
GC	GENERAL CEMENT
GCON	GENERAL CONTROL
GE	GENERAL ELECTRIC
GLA	GEELAR
GL	GLOBAR
GR	GENERAL RADIO
GRHL	GRAYHILL
GRIS	GRIGSBY CO.
GU	GUDEMAN
GV	G. V. CONTROL
HAW	HARTWELL
HAYS	HAYS MFG.
HE	HEINEMANN
HEY	HEYCO
HP	HEWLETT PACKARD
HGR.	H. G. REISING
HL	HELIPOT
HOF	HOFFMAN
HOP	HOPKINS
HS	HARDWARE SPEC.
HU	HUBBEL
HY	HYCOR
HYD	HAYDON
IGNS	INGERSOL RAND
IL	ILSCO
ILG	ILG
IMP	IMPERIAL
INSU	INSULINE
IRC	INT. RESISTOR CORP.
IREC	INT. RECTIFIER CORP.
IS	INSULATION SUPPLY
ITE	ITE CIRCUIT BREAKER
J	JOHNSON
JAN	JAN HARDWARE MFG.
JE	JEFFERSON
JEN	JENSEN
K	KIERLUFF
KENR	KEINER
KH	KRON-HITE
KING	KING
KT	KOOLTRONIC
KU	KULKA
KZ	KURZ-KASCH
LA	LYNCH ASBESTOS
LAMB	LAMBDA
LAR	L. A. RESISTOR
LE	LEACH
LER	LERCO
LI	LITTLE FUSE
LING	LING ELECTRONICS DIV.
LMB	LMB
LP	LAPP
LPD	LA-DEAU PROD.
LUNK	LUNKENHEIMER
M	MILLEN
MA	MALLORY
MD	MICRODOT
ME	METTSCRAFT
MEC	MEC
MH	MINNEAPOLIS HONEYWELL
MICA	MICAMOLD
MIN	MINARIK
ML	MACHLETT
MLR.	MILLER CO.
MMN	MARMON
MN	MARION
MOD	MODULONICS
MON	MONITOR
MOSE	MOSELEY
MOSS	MOSSMAN
MRC	MARCO
MRY	MURRAY
MS	MICROSWITCH
MTRO	MOTOROLA
N	NATIONAL CO.
NC	NATIONAL WIRE & CABLE
NE	NETWORK MFG.
NEI	NATIONAL ELECTRONICS INC.
NEP	NATIONAL ELECTRICAL PROD.
NHBB	NEW HAMPSHIRE BALL BEARING
NIBCO	NORTHERN INDIANA BRASS
NL	NATIONAL LOCK
O	OHMITE
OZ	O.Z. ELECTRICAL MFG CO.
PAN	PANDUIT
PANX	PANDUX
PCA	PCA
PE	PEERLESS
PENN	PENN CONTROL
PER	PERMOID
PH	PHILLIPS CONTROL (PHILTROL)
PHIL	PHILBRICK RESEARCH
PREM.	PREMIER METAL PROD.
PRKR	PARKER ELECTRICAL INST.
PRYN	PRYNE
PTB	POTTER - BRUMFIELD
PY	PYRAMID
QE	QUALITY ELECTRIC
R	ROTRON
RAY	RAYTHEON
RBC	RUBBERCRAFT
RCA	RADIO CORP. OF AMER.
RCC	RADIO CONDENSER CO.
RDL	RADIO DEVELOPMENT LAB
RE	REPUBLIC GLASS
REN	RENBRANDT
ROB	ROBERTSHAW-FULTON CON.
ROME	ROME
RT	RATIGAN
RY	RYTRON
S	SIMPSON
SA	SANGAMO
SAR	SARAN
SE	SERVICE
SEL	SELCO
SEP	STANDARD ELECT. PROD.
SH	SHALL CROSS
SI	SIGMA
SIE	SOUTHWESTERN IND. ENG.
SKT	SARKES TARZIAN
SK	SPENCER-KENNEDY-LABS.
SM	STANLEY MORRIS
SMC	SPECIALTIES MFG.
SMI	SMITH HERMAN
SOLA	SOLA ELECTRIC
SOR	SORENSON
SP	SPRAGUE
SPR	SUPREME
SQ	SQUARE D
SR	SIERRA ELECT. CORP.
SREC	STANDARD RECTIFIER
SS	SPECTRA-STRIP
STAH	STAHLIN BROS.
STAN	STANTRON
STIM	STIMSON, E.B.
STW	STANDARD WIRE & CABLE
SU	SUPERIOR ELECTRIC
SUPT	SUPRENANT
SW	SWITCHCRAFT
SW-CT	SWITCHING CONTROL
SWGL	SWAGELOCK
SY	SYLVANIA
T	TRIAD
T & B	T & B (CONNECTORS)
TH	THERMADOR
TI	TEXAS INSTRUMENT
TIC	TECHNOLOGY INST. CORP.
TNG	TUNGSOL
TR	TRUMBEL
TRAN	TRANSELECTRONICS
TRE	TRERICE
TRIM	TRIMM
TRID	TRID LABS. INC.
TX	TEKTRONIX
UI	UNISTRUT
ULAN	ULANET CO., GEO.
UN	UNIMAX
USDC	U. S. ELECT. DEVEL.
USEC	U. S. ENG. CO.
USG	U. S. GAUGE
UTAH	UTAH
UTC	UNITED TRANSFORMER
VAL	VALOR INSTRUMENTS INC.
WA	WALSCO
WAFD	WAKEFIELD ENGR.
WAT	WATERS
WB	WARNER BRAKE
WC	WEST COAST (WESCO)
WE	WESTINGHOUSE
WEL	WELWYN
WES	WESTON
WH	WAHLGREN
WHD	WEATHERHEAD
WHIT	WHITLOCK
WIN	WINCHESTER
WK	WECKESSER
WL	WARD LEONARD
WP	WESTCAP
WRMD	WIRE MOULD
WRNE	WESTERN ELECTRIC
WSPT	WESTPORT
WYCO	WYCO METAL PROD.
YO	YOUNG RADIATOR

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